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"Rocket Studies of the Lower Ionosphere During the IQSY"

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## I. Introduction

This grant is for study and experiment pertaining to the D- and E-regions of the ionosphere, as part of the United States program for the International Years of the Quiet Sun.

## II. Work Accomplished to Date

The vertical incidence sounder field station at Wallops Island, Virginia, was completed and put into operation during April, 1964. The pulse transmitter was installed and transmitting antennas erected at a site selected on the island. Receiving and data recording equipment was installed and an array of receiving loop antennas was constructed on the main base. A radio link was installed to synchronize data recording equipment with transmitter operation. This sounder system was operated successfully during the firing of Nike-Apache rocket 14.143 on April 15, 1964. Much of the data obtained during this and subsequent operations has been reduced. Minor modifications to the Wallops Island sounder timing and control systems were made and additional data taken during June, 1964.

Three successful rockets were fired from Wallops Island on July 15, 1964. These were fired at critical periods prior to, during and after sunrise to obtain data on pre-sunrise changes in the structure of the ionosphere. The vertical-incidence sounder was also operated during this period. Data from both the airborne instrumentation and the sounder are being analyzed.

By arrangement between the International Programs Office of NASA and the British National Space Committee, an impedance probe developed by Prof. J. Sayers of the University of Birmingham, England, was furnished

for the comparison of its performance with the other experiments on the D-region payload. The Type B payload was specifically developed for this purpose. A successful flight of this payload took place on July 16, 1964, and the impedance probe appeared to work satisfactorily. It might be noted that this success follows no less than five unsuccessful attempts by the University of Birmingham group to fly their probe on various European rockets; vehicle failures having been the principal difficulty.

In addition, the Type B payload carried a gold-plated spherical probe of the type used by the Japanese workers, as an ion collector with a large negative potential applied to it. This also worked successfully in July.

A new receiving array was constructed during September at the Wallops Island field station to improve reception of the echo signal and to aid in reducing the level of man-made interference received.

Work has been completed on the design and construction of an additional sounder for shipboard use in connection with the NASA mobile launch program. A shielded, tunable pulse transmitter was designed and constructed with the greater mechanical rigidity necessary for mobile service. A tunable receiver was also designed. Two receivers have been constructed, one of which is to serve as a backup unit. The entire system is being installed in an equipment van, in which a small laboratory facility will be included for maintenance of the system. Modifications were made to the van power system to conform to the standards of the mobile launch power facilities.

Design of the antenna array for shipboard use has been accomplished with the aid of antenna pattern range measurements made on a scaled

model of the proposed system. Antenna impedance matching networks have been designed, constructed and fitted with weathertight enclosures for mounting on the deck of the ship. A fast-recovery T-R gate has been designed to allow diplexing of the antenna array for use in both transmitting and receiving.

Investigation of the characteristics of rocket-borne probes for direct measurement of electron density in the upper atmosphere has continued. A laboratory has been equipped to provide controlled conditions for measurements of various probe configurations. Results of this experimental work are being compared to theoretically-derived data.